

# Speaker Identification (SID) in Low-Rate Coded Speech

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Effect of Transmission on Multimedia Quality of Service

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ITS



# SID: Motivation

- New equipment for first responders
- Anecdotal complaints about system performance
  - Speaker emotional state, and speaker identity obscured
- Legitimate concerns!

# SID: Motivation

- To help improve the platform, these problems must be measured
- Two experiments were designed to measure the problem
- We'll be talking about SID today

# SID: Experiment Design

- Specifications:
  - Unfamiliar talkers
  - Clips with and without prosodic information (short and long clips)
  - Six simulated communication systems
  - Manageable experiment length

# SID: Experiment Design

- Realization:
  - Tactical Speaker Identification Database
    - Used three males and three females
  - Three clip lengths: sentence, four digits, two digits
  - MELP, IMBE 7.2, 3.6 kbps (with and without impairments), MNRU
  - 360 total clips, experiment length around one hour

# SID: Experiment Design

- CI clips produced by resampling at 8 kHz, filtering (160-3640 Hz bandpass), and then normalized to -26 dB below clipping
- Low-rate vocoders in C2, C3, C5 and C6 are similar to those used in Public Safety communication systems
- C5 and C6 have additional transmission impairments

Condition (C)	Description
C1	Null (no further processing)
C2	IMBE Codec, 7.2-kbps gross 4.4-kbps net
C3	MELP Codec, 1.2-kbps net
C4	MNRU, $Q = 6$ dB SNR
C5	IMBE Codec, 3.6-kbps gross 2.45-kbps net 7% BER, random
C6	C5+Packet Impairments+C5 Packet Impairments: create 60 ms packets, delete 10% of packets at random, insert the same number of empty packets at random and apply PLC to them

**Table 1.** Six conditions used in the experiment.

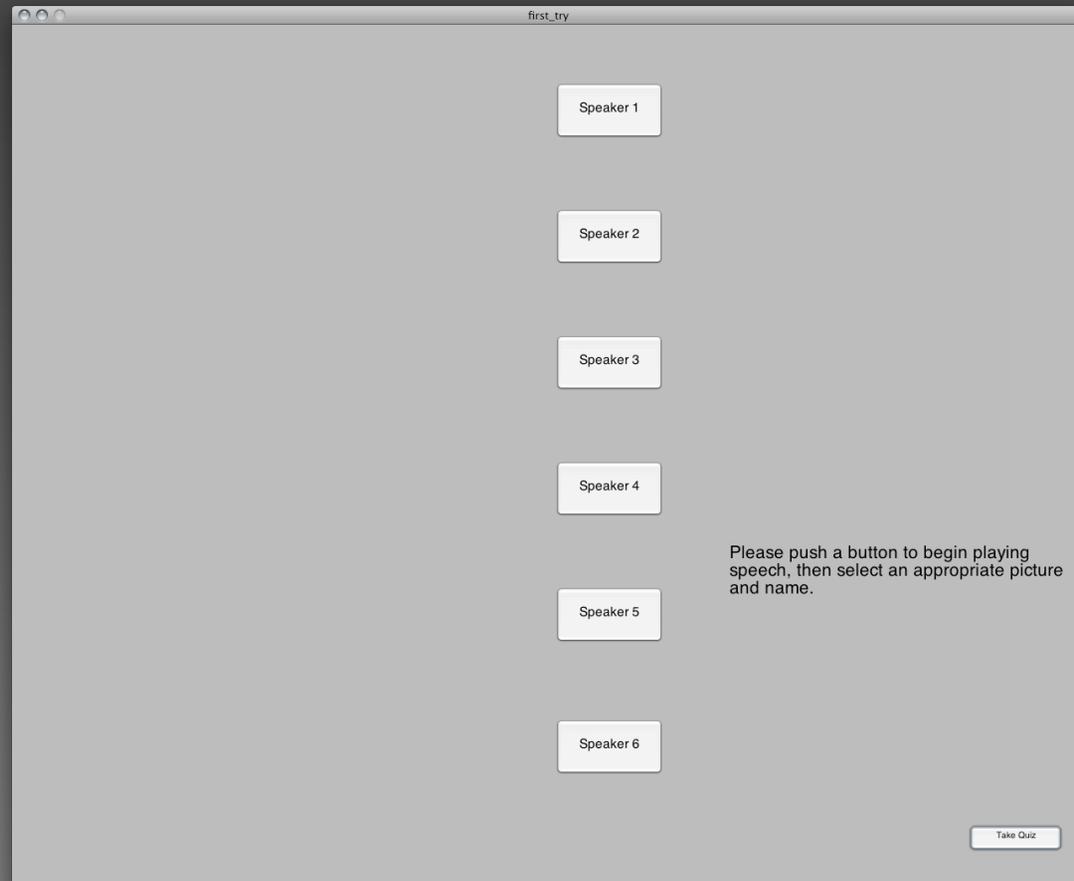
# SID: Experiment Design

- Problems:
  - Training listeners to accurately recognize any given speaker
  - False confidence in training
  - Mid-test mistraining

# SID: Experiment Design

- Training:
  - Used set of clips where speakers were giving directions (semi-spontaneous)
  - Allowed listeners to assign appropriate memory aids: a name and a face

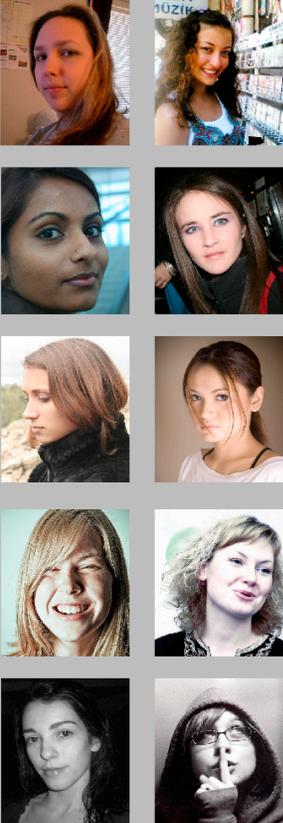
# SID: Experiment Design



# SID: Experiment Design

first\_try

Chose a name...



- Mary
- Patricia
- Linda
- Barbara
- Elizabeth
- Jennifer
- Maria
- Susan
- Margaret
- Dorothy
- Lisa
- Nancy
- Karen
- Betty
- Heleen
- Sandra
- Donna
- Carol
- Ruth
- Sharon
- Michelle
- Laura
- Sarah
- Kimberly
- Deborah
- Jessica
- Shirley
- Cynthia
- Angela
- Melissa
- Brenda
- Amy
- Anna
- Rebecca
- Virginia
- Kathleen
- Patricia
- Martha
- Olivia
- Amanda
- Stephanie
- Carolyn
- Christine
- Marie
- Janel
- Catherine
- Frances
- Ann
- Joyce
- Diane
- Alice
- Julie
- Heather
- Teresa
- Doris
- Gloria
- Evelyn
- Jean
- Cheryl
- Mildred
- Katherine
- Jean
- Ashley
- Judith
- Rose
- Janice
- Kelly
- Nicole
- Judy
- Cristina
- Kathy
- Theresa
- Beverly
- Denise
- Tammy
- Irene
- Jane
- Lori
- Rachel
- Marilyn
- Andrea
- Kathryn
- Louise

...or type a name.

Speaker 1

Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6

Now playing speaker 1.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

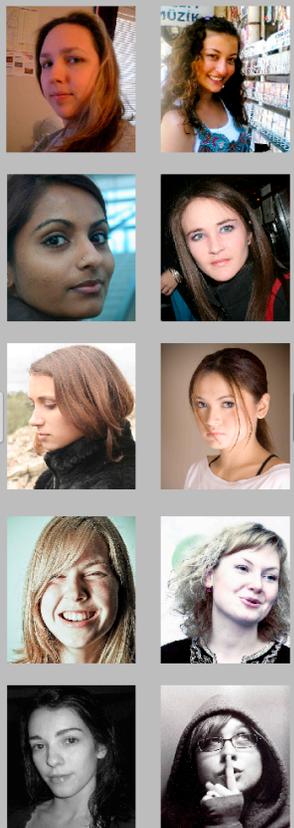
Stop Audio

Take Quiz

# SID: Experiment Design

first\_try

Chose a name...



- Caro
- Stefanie
- Rozario
- Ola
- Janine
- Mollie
- Lucie
- Alisa
- Lou
- Maribel
- Suzanne
- Betta
- Suzana
- Eiso
- Cecile
- Isabelle
- Lesley
- Jocelyn
- Paige
- John
- Rachelle
- Lucia
- Daphne
- Alta
- Esther
- Patra
- Graciela
- Imogene
- Jolene
- Keisha
- Lacey
- Genia
- Gabriela
- Keri
- Ursula
- Lizze
- Kristen
- Shana
- Adelino
- Maria
- Jayne
- Jaclyn
- Grace
- Sondra
- Carmela
- Manisa
- Rosalind
- Charity
- Tonia
- Beatriz
- Mansci
- Clance
- Jeanne
- Sheena
- Angeline
- Frieda
- Lily
- Robbie
- Shauna
- Millie
- Claudette
- Callieann
- Angela
- Gabrielle
- Autumn
- Katharine
- Summer
- Jodie
- Staci
- Lea
- Christi
- Jimmie
- Justine
- Erna
- Lynella
- Margot
- Dominique
- Socorro
- Henna
- Martina
- Margo
- Mavis
- Callie

Speaker 1

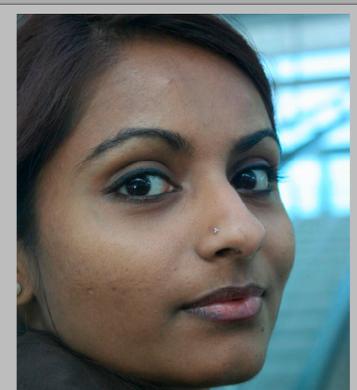
Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6



Now playing speaker 1.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

Stop Audio

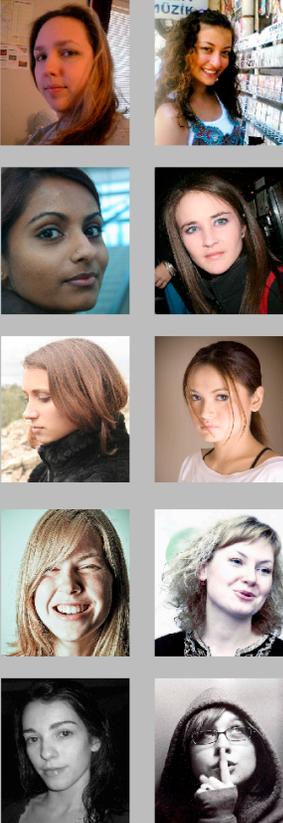
Take Quiz

...or type a name.

# SID: Experiment Design

first\_try

Chose a name...



- Caro
- Stefano
- Rosario
- Ola
- Janine
- Molie
- Lucie
- Alicia
- Lou
- Maribel
- Suzanne
- Betta
- Suzana
- Eiso
- Cecile
- Isabelle
- Lesley
- Jocelyn
- Paige
- John
- Rachelle
- Lucia
- Daphne
- Alta
- Esther
- Patra
- Graciela
- Imogene
- Jolene
- Kenisha
- Lacey
- Genia
- Gabriela
- Ursula
- Lizsie
- Kirsten
- Shana
- Adelino
- Maria
- Jayne
- Jaclyn
- Grace
- Sondra
- Carmela
- Maria
- Rosalind
- Charity
- Tonia
- Beatriz
- Mansci
- Clance
- Jeanne
- Sheena
- Angeline
- Frieda
- Lily
- Robbie
- Shauna
- Millie
- Claudette
- Cathleen
- Angela
- Gabrielle
- Autumn
- Katharine
- Summer
- Jodie
- Staci
- Lea
- Christi
- Jimmie
- Justine
- Erna
- Lynella
- Margot
- Dominique
- Socorro
- Henna
- Martina
- Margo
- Mavis
- Callie

Speaker 1

Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6



Keri

Now playing speaker 1.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

Stop Audio

Take Quiz

...or type a name.

# SID: Experiment Design

first\_try

Chose a name...



James  
John  
Robert  
Michael  
William  
David  
Richard  
Charles  
Joseph  
Thomas  
Christopher  
Daniel  
Paul  
Mark  
Donald  
George  
Kenneth  
Steven  
Edward  
Brian  
Ronald  
Anthony  
Kevin  
Jason  
Matthew  
Gary  
Timothy  
Jose  
Larry  
Jeffrey  
Frank  
Scott  
Eric  
Stephan  
Andrew  
Raymond  
Gregory  
Joshua  
Jeremy  
Dennis  
Walter  
Patrick  
Peter  
Harold  
Douglas  
Henry  
Carl  
Arthur  
Ryan  
Roger  
Joe  
Juan  
Jack  
Albert  
Jonathan  
Justin  
Terry  
Gerald  
Keith  
Samuel  
Wille  
Rauch  
Lawrence  
Nicholas  
Roy  
Benjamin  
Bruce  
Brandon  
Adam  
Harry  
Fred  
Wayne  
Billy  
Steve  
Louis  
Jeremy  
Aaron  
Randy  
Howard  
Eugene  
Carlos  
Russell  
Donna...

...or type a name.

Speaker 1

Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6

Now playing speaker 2.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

Stop Audio

Take Quiz



# SID: Experiment Design

first\_try

Chose a name...



- James
- John
- Robert
- Michael
- William
- David
- Richard
- Charles
- Joseph
- Thomas
- Christopher
- Daniel
- Paul
- Mark
- Donald
- George
- Kenneth
- Steven
- Edward
- Brian
- Ronald
- Anthony
- Kevin
- Jason
- Matthew
- Gary
- Timothy
- Jose
- Larry
- Jeffrey
- Frank
- Scott
- Eric
- Stephan
- Andrew
- Raymond
- Gregory
- Joshua
- Jeremy
- Dennis
- Walter
- Patrick
- Peter
- Harold
- Douglas
- Henry
- Carl
- Arthur
- Ryan
- Roger
- Joe
- Juan
- Jack
- Albert
- Jonathan
- Justin
- Terry
- Gerard
- Kath
- Samuel
- Wille
- Ralph
- Lawrence
- Nicholas
- Roy
- Benjamin
- Bruce
- Brandon
- Adam
- Harry
- Fred
- Wayne
- Billy
- Steve
- Louis
- Jeremy
- Aaron
- Randy
- Howard
- Eugene
- Carlos
- Russell
- Donna...

...or type a name.

Speaker 1

Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6



Now playing speaker 2.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

Stop Audio

Take Quiz

# SID: Experiment Design

The screenshot shows a software window titled "first\_try" with the following components:

- Name Selection Grid:** A 5x2 grid of 10 small portrait photos of different men.
- Name List:** A scrollable list of names including James, John, Robert, Michael, William, David, Richard, Charles, Joseph, Thomas, Christopher, Daniel, Paul, Mark, Donald, George, Kenneth, Steven, Edward, Brian, Ronald, Anthony, Kevin, Jason, Matthew, Gary, Timothy, Jose, Larry, Jeffrey, Frank, Scott, Eric, Stephen, Andrew, Raymond, Gregory, Joshua, Jerry, Jonathan, Walter, Patrick, Peter, Harold, Douglas, Henry, Carl, Arthur, Ryan, Roger, Jose, Juan, Jack, Albert, Jonathan, Justin, Terry, Gerald, Keith, Samuel, Willie, Rauch, Lawrence, Nicholas, Roy, Benjamin, Bruce, Brandon, Adam, Harry, Fred, Wayne, Billy, Steve, Louis, Jeremy, Aaron, Randy, Howard, Eugene, Carlos, Russell, and Bob.
- Buttons:** Six buttons labeled "Speaker 1" through "Speaker 6" are arranged vertically.
- Large Image:** A large portrait of a man with short brown hair and a grey shirt, labeled "Dennis".
- Text:** Below the large image, it says "Now playing speaker 2." and "Please pick an appropriate picture and select or type an appropriate name for the current speaker."
- Input Fields:** A text box with the prompt "...or type a name." and a "Stop Audio" button.

# SID: Experiment Design

first\_try

Chose a name...

Mary  
Patricia  
Linda  
Barbara  
Elizabeth  
Jennifer  
Mona  
Susan  
Margaret  
Dorothy  
Lisa  
Nancy  
Karen  
Betty  
Helen  
Sandra  
Dorinda  
Carol  
Ruth  
Sharon  
Michelle  
Laura  
Sarah  
Katherine  
Deborah  
Jessica  
Shirley  
Cynthia  
Angela  
Melissa  
Brenda  
Amy  
Anna  
Rebecca  
Virginia  
Kathleen  
Patricia  
Martha  
Debra  
Stephanie  
Carolyn  
Christine  
Marie  
Janet  
Catherine  
Frances  
Ann  
Joyce  
Diane  
Alice  
Julie  
Heather  
Teresa  
Doris  
Gloria  
Evelyn  
Jean  
Cheryl  
Mildred  
Katherine  
Joan  
Ashley  
Judith  
Rose  
Janice  
Kelly  
Nicole  
Judy  
Cristina  
Kathy  
Theresa  
Beverly  
Denise  
Tammy  
Irene  
Jane  
Lori  
Rachel  
Marylyn  
Andrea  
Kathryn  
Louise

...or type a name.

Speaker 1

Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6

Now playing speaker 3.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

Stop Audio

Take Quiz

# SID: Experiment Design

first\_try

Chose a name...



- Mary
- Patricia
- Linda
- Barbara
- Elizabeth
- Jennifer
- Maria
- Susan
- Margaret
- Dorothy
- Lisa
- Nancy
- Karen
- Betty
- Heleen
- Sandra
- Donna
- Carol
- Ruth
- Sharon
- Michelle
- Laura
- Sarah
- Kimberly
- Deborah
- Jessica
- Shirley
- Cynthia
- Angela
- Melissa
- Brenda
- Amy
- Anna
- Rebecca
- Virginia
- Kathleen
- Patricia
- Martha
- Debra
- Christina
- Stephanie
- Carolyn
- Christine
- Maria
- Jamie
- Catherine
- Frances
- Ann
- Joyce
- Diane
- Alice
- Julie
- Heather
- Teresa
- Doris
- Gloria
- Evelyn
- Jean
- Cheryl
- Mildred
- Katherine
- Jean
- Ashley
- Judith
- Rose
- Janice
- Kelly
- Nicole
- Judy
- Cristina
- Kathy
- Theresa
- Beverly
- Denise
- Tammy
- Irene
- Jane
- Lori
- Rachel
- Marilyn
- Andrea
- Kathryn
- Louise

...or type a name.

Speaker 1

Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6

Now playing speaker 3.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

Stop Audio

Take Quiz

# SID: Experiment Design

first\_try

Chose a name...



- Mary
- Patricia
- Linda
- Barbara
- Elizabeth
- Jennifer
- Maria
- Susan
- Margaret
- Dorothy
- Lisa
- Nancy
- Karen
- Betty
- Heleen
- Sandra
- Donna
- Carol
- Ruth
- Sharon
- Michelle
- Laura
- Sarah
- Kimberly
- Deborah
- Jessica
- Shirley
- Cynthia
- Angela
- Melissa
- Brenda
- Amy
- Anna
- Rebecca
- Virginia
- Kathleen
- Patricia
- Olivia
- Stephanie
- Carolyn
- Christine
- Maria
- Janel
- Catherine
- Frances
- Ann
- Joyce
- Diane
- Alice
- Julie
- Heather
- Teresa
- Doris
- Gloria
- Evelyn
- Jean
- Cheryl
- Mildred
- Katherine
- Jean
- Ashley
- Judith
- Rose
- Janice
- Kelly
- Nicole
- Judy
- Cristina
- Kathy
- Theresa
- Beverly
- Denise
- Tammy
- Irene
- Jane
- Lori
- Rachel
- Marilyn
- Andrea
- Kathryn
- Louise

...or type a name.

Speaker 1

Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6



Now playing speaker 3.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

Stop Audio

Take Quiz

# SID: Experiment Design

first\_try

Chose a name...



- Mary
- Patricia
- Linda
- Barbara
- Elizabeth
- Jennifer
- Maria
- Susan
- Margaret
- Dorothy
- Lisa
- Nancy
- Karen
- Betty
- Heleen
- Sandra
- Donna
- Carol
- Ruth
- Sharon
- Michelle
- Laura
- Sarah
- Kimberly
- Deborah
- Jessica
- Shirley
- Cynthia
- Angela
- Patricia
- Brenda
- Amy
- Anna
- Rebecca
- Virginia
- Kathleen
- Parvula
- Martha
- Olivia
- Amanda
- Stephanie
- Carolyn
- Christine
- Maria
- Janel
- Catherine
- Frances
- Ann
- Joyce
- Diane
- Alice
- Julie
- Heather
- Teresa
- Doris
- Gloria
- Evelyn
- Jean
- Cheryl
- Mildred
- Katherine
- Jean
- Ashley
- Judith
- Rose
- Janice
- Kelly
- Nicole
- Judy
- Cristina
- Kathy
- Theresa
- Beverly
- Denise
- Tammy
- Irene
- Jane
- Lori
- Rachel
- Marilyn
- Andrea
- Kathryn
- Louise

Speaker 1

Speaker 2

Speaker 3

Speaker 4

Speaker 5

Speaker 6



Melissa

Now playing speaker 3.

Please pick an appropriate picture and select or type an appropriate name for the current speaker.

...or type a name.

Stop Audio

Take Quiz